REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
28-06-2019	Summary Report	22 August - 21 February 2019

4. TITLE AND SUBTITLE
Ultra-Flexible Photo-voltaic (PV) Phase I SBIR

5a. CONTRACT NUMBER
W911QY-18-P-0174

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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5d. PROJECT NUMBER
A181-067-1510

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
USA Soldier System CTR
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Natick, MA 01760-5000

10. SPONSOR/MONITOR'S ACRONYM(S)
CCDC - Combat Capabilities Development Center

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Public Release A

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The project consisted of taking SunPower solar cells, cutting them down to a size small enough to produce a tile like structure, making electrical contact to the back side of these cells then interconnecting the cells together to produce a photovoltaic array. The Phase I contract was broken down into 5 parts a summary of each these parts is listed below.

15. SUBJECT TERMS
Solar, Amorphous Silicon, Ultra-Flexible, Photo-voltaic

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Wesley White
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For the United States Army

USA SOLDIER SYSTEM CTR,
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PowerFilm
Ultra-Flexible PV Phase 1 SBIR

Summary Report on
Contract No. W911QY-18-P-0174
(Ultra-Flexible PV phase I SBIR)

Summary Report

Dates Covered: 22 August – 21 February 2019

Submitted by

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PowerFilm, Inc.
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(Final Report submitted 12 April 2019)

Unclassified

Project Description

The modern Military has an ever-increasing need for power, in particular light-weight portable power with high power densities and decreased deployed foot print. Currently packable panels are made from light weight Amorphous Silicon or carbon fiber backed crystalline silicon. Amorphous Silicon technology has low power conversion efficiency and Carbon fiber backed crystalline is breakable. The solution to this is to take the benefits of the two different technologies and combine them to produce a solar fabric that has high power conversion and ultra-flexibility. To achieve the two greatest challenges of this project, compound curve tolerance and high efficiency, PowerFilm proposes the following solution; to make an ultra-flexible photovoltaic sheet on a flex substrate with tiles of high efficiency crystalline silicon.

Description of technology being developed

The project consisted of taking SunPower solar cells, cutting them down to a size small enough to produce a tile like structure, making electrical contact to the back side of these cells then interconnecting the cells together to produce a photovoltaic array. The Phase I contract was broken down into 5 parts a summary of each these parts is listed below.

Phase 1 results

Flex Circuit Design

The PCB artwork that was designed under this contract worked very well, and for this type of a design - no further work is needed. Matching the back-side cell traces to the PCB, without having the original artwork from the cell manufacturer, was also completely figured out and no further work would be required on this task going forward.

Cell Cutting

This task was thought to be one of the easier tasks going into the contract, however what was discovered is that cutting a cell and keeping the performance high is no easy feat. In the end it required specialized cutting platen, a focused gaussian laser beam, and removal of the back-side metal on the solar cell. Without this contract this would not have been known, however success was had and cell cuts were made without affecting the solar cell performance

Stencil Design

This task was also considered a success; the stencil is the means to put down the solder paste to which bonds the cell to the PCB. There was concern that the alignment between the cell and the PCB would be super critical. However, what PowerFilm found out was the cells would self-align to the traces on the board almost every time.

Array Assembly

Array assembly was also considered a success, everything from stringing together the cells, encapsulating, and mounting on fabric was pretty much standard operation here at PowerFilm

Array Encapsulation
Using the encapsulation materials that were designed for thin film amorphous products to build the highly flexible crystalline array worked flawlessly

Overall PowerFilm feels the Phase 1 SBIR Ultralight Weight Photovoltaic project was a huge success. This contract took a number of great ideas and put them into reality. PowerFilm feels that this technology could be the low cost, high performance, durable, light weight solar module of the future.

DoD and or non-DoD Customers

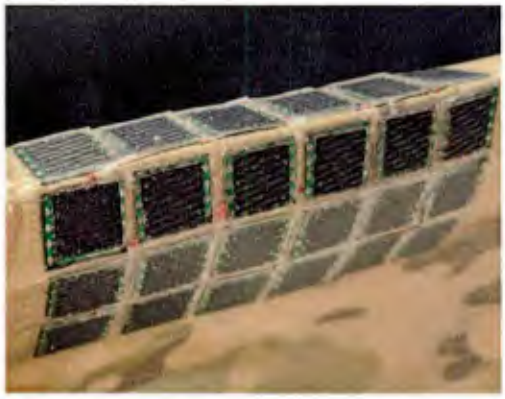
Dismounted Soldier, remote sensors, remote radio installation, mounted Soldier and vehicles are some of the DoD customers. Non-DoD customers include hikers/backpackers, border patrol, remote exploration crews, mountaineers, county sheriffs, first responders to name a few.

Transition Plan

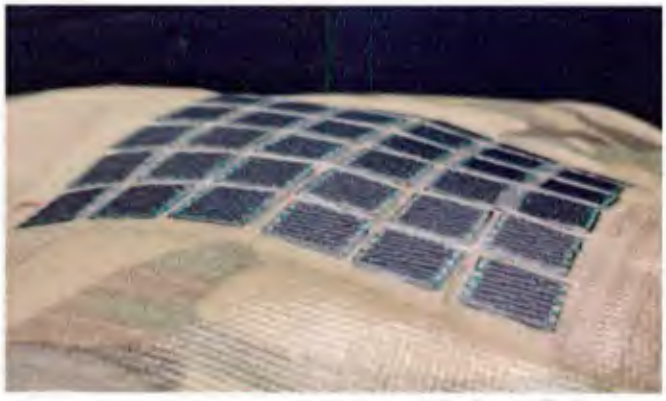
The current plan is to use phase 2 funding to increase the manufacturing capability of this technology. This involves interfacing with automated SMT (Surface Mount Technology), to produce tiles without manual labor. In addition, designing automation for automatic cell cutting, sorting, and testing to feed SMT assembly lines. Encapsulation of the tiles of cells and parallel and series arrangement of the arrays is currently a known implemented technology at PowerFilm.

Application/benefits for Government and or private sector use

This technology is the bridge between thin lightweight amorphous technologies and extremely expensive GaAs photovoltaic arrays. This technology boosts the electrical conversion efficiency of the fielded solar panel from 5% to 15% without increasing the cost to the user. Both DoD and Non-DoD customers who are looking for more power in a smaller area at a reduced cost will benefit from this technology development.



1cm cells wrapped around a 6.35mm radius rod.



1cm x 1cm cells mounted on Litelock Fabric

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